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In re application of: Martin Schmatz

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Washington, D.C. 20231

SUBMISSION OF PRIORITY DOCUMENT

Sir:

Enclosed herewith is a certified copy of EPO Application No. 00810715.3 filed August 11, 2000 , in support of applicant's claim to priority under 35 U.S.C. 119.

Respectfully submitted,

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Claims

1. An optical detector (20) for receiving an optical signal transmitted via an optical fibre cable (30), the detector (20) comprising:

an array of photo-sensors (50) for location in the path of the optical signal; and

a controller (60) for detecting which of the photo-sensors (50) receives the optical signal in use, and deriving a received signal from an output of any said photo-sensor (50) so detected.

2. An optical detector (20) as claimed in claim 1, wherein the controller (60) comprises: DC extraction circuitry (70) for extracting a DC component from the output of each photo-sensor (50) in the array; AC extraction circuitry (80) for extracting an AC component from the output of each photo-sensor (50) in the array; and, multiplier circuitry coupled to the DC extraction circuitry (70) and to the AC extraction circuitry (80) for generating a separate multiplier output based on the AC component and the DC component of the output of each photo-sensor (50) in the array.

3. An optical detector (20) as claimed in claim 2, wherein each multiplier output is based on the product of the AC component and the DC component of the output of the corresponding photo-sensor (50).

4. An optical detector (20) as claimed in claim 2 or claim 3, wherein the controller (60) comprises summation circuitry (100) coupled to the multiplier circuitry (90) for combining the multiplier outputs to generate the received signal.

5. An optical detector (20) as claimed in claim 4, wherein the DC extraction circuitry (70) comprises a plurality of DC extraction circuits (110) each corresponding to a different one of the photo-sensors (50) and the AC extraction circuitry (80) comprises a plurality of AC extraction circuits (120) each corresponding to a different one of the photo-sensors (50).

6. An optical detector (20) as claimed in claim 5, wherein each DC extraction circuit (110) comprising a DC current sensor (150) coupled to the corresponding photo-sensor (50).

7. An optical detector (20) as claimed in claim 5 or claim 6, wherein each AC extraction circuit (120) comprises a transimpedance amplifier (160) coupled to the corresponding photo-sensor (50).

8. An optical detector (20) as claimed in any of claims 2 to 7, wherein the multiplier circuitry (90) comprising a plurality of multiplier circuits (130) each corresponding to a different one of the photo-sensors (50).

9. An optical detector (20) as claimed in claim 2, wherein the DC extraction circuitry (70) comprises circuitry for extracting the DC component based on the AC signal strength of the output of each photo-sensor (50) in the array.

10. An optical detector (20) as claimed in claim 2, wherein the multiplier circuitry (90) comprises a switch.

11. An optical detector (20) as claimed in claim 10, wherein the switch has a hysteresis.

12. An optical detector (20) as claimed in any preceding claim, wherein each photo-sensor (50) in the array comprises a photo-diode (140).

13. An optical detector (20) as claimed in any preceding claim, wherein the array of photo-sensors (50) comprises a two dimensional array of photo-sensors (50).

14. An optical communication system comprising: at least one optical fibre (30) and an optical detector (20) as claimed in any preceding claim facing an end of the optical fibre (30).

15. A method for receiving an optical signal transmitting via an optical fibre cable (30), comprising:

locating an array of photo-sensors (50) in the path of the optical signal; detecting which of the photo-sensors (50) receives the optical signal; and, deriving a received signal from an output of any said photo-sensor (50) so detected.

16. A method as claimed in claim 15, comprising: extracting a DC component from the output of each photo-sensor (50) in the array; extracting an AC component from the output of each photo-sensor (50) in the array; and, generating a separate multiplier output based on the AC component and the DC component of the output of each photo-sensor (50) in the array.

17. A method as claimed in claim 16, wherein each multiplier output is based on the product of the AC component and the DC component of the output of the corresponding photo-sensor (50).

18. A method as claimed in claim 16 or claim 17, comprising combining the multiplier outputs to generate the received signal.

of each photo-sensor in the array. Such method may also comprise combining the products of the AC component and the DC component of the outputs of the photo-sensors to generate the received signal.

Brief Description of the Drawings

Preferred embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a block diagram of an optical communication system embodying the present invention;

Figure 2 is a block diagram of an optical detector of the optical communication system;

Figure 3 is a block diagram of a controller of the optical detector;

Figure 4 is another block diagram of a controller of the optical detector; and,

Figure 5 is a block diagram of AC and DC extraction circuit portions of the controller.

Description of the Preferred Embodiment

Referring to Figure 1, an example of an optical data communication system embodying the present invention comprises a transmitter 10 and a detector 20 interconnected by an optical fibre 30. In operation, at the transmitter 10, light is modulated by an electrical data signal 40 to be transmitted. The modulated light is injected into one end of the fibre 30. The detector 20, at the other end of the fibre 20, converts incident light from the fibre 30 back into the electrical data signal.

In preferred embodiments of the present invention, the controller comprises summation circuitry coupled to the multiplier circuitry for combining the multiplier outputs to generate the received signal.

The DC extraction circuitry may comprise a plurality of DC extraction circuits each corresponding to a different one of the photo-sensors. Similarly, the AC extraction circuitry may comprise a plurality of AC extraction circuits each corresponding to a different one of the photo-sensors. Each DC extraction circuit may comprise a DC current sensor coupled to the corresponding photo-sensor. Each AC extraction circuit may comprise a transimpedance amplifier coupled to the corresponding photo-sensor.

In particularly preferred embodiments of the present invention, the multiplier circuitry comprises a plurality of multiplier circuits each corresponding to a different one of the photo-sensors.

In preferred embodiments of the present invention the array of photo-sensors comprises a two dimensional array of photo-sensors. Each photo-sensor in the array may conveniently comprise a photo-diode.

It will be appreciated that the present invention extends to an optical communication system comprising: at least one optical fibre and an optical detector as claimed in any preceding claim facing an end of the optical fibre.

Viewing the present invention from another aspect, there is now provided a method for receiving an optical signal transmitting via an optical fibre cable, comprising: locating an array of photo-sensors in the path of the optical signal; detecting which of the photo-sensors receives the optical signal; and, deriving a received signal from an output of any said photo-sensor so detected.

Such a method preferably comprises: extracting a DC component from the output of each photo-sensor in the array; extracting an AC component from the output of each photo-sensor in the array; and, generating the product of the AC component and the DC component of the output

Abstract

An optical detector (20) for receiving an optical signal transmitting via an optical fibre cable (30), comprises an array of photo-sensors (50) for location in the path of the optical signal. A controller a controller (60) detects which of the photo-sensors (50) receives the optical signal in use, and derives a received signal from an output of any said photo-sensor (50) so detected.

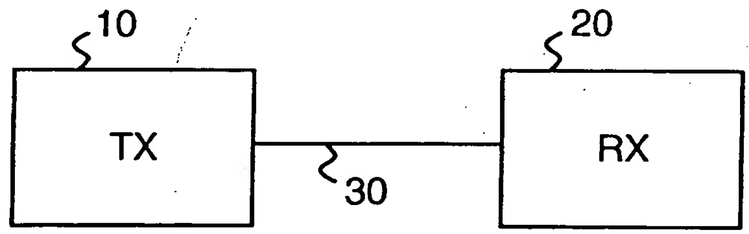

Figure 1

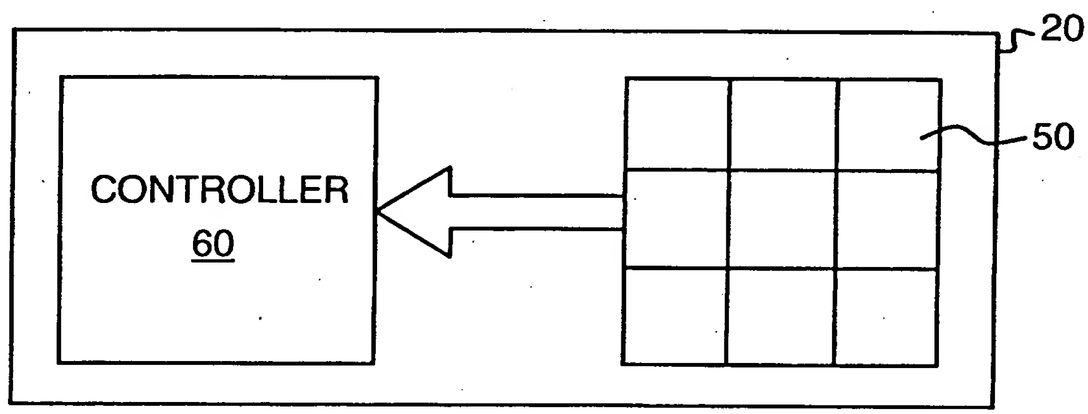

Figure 2

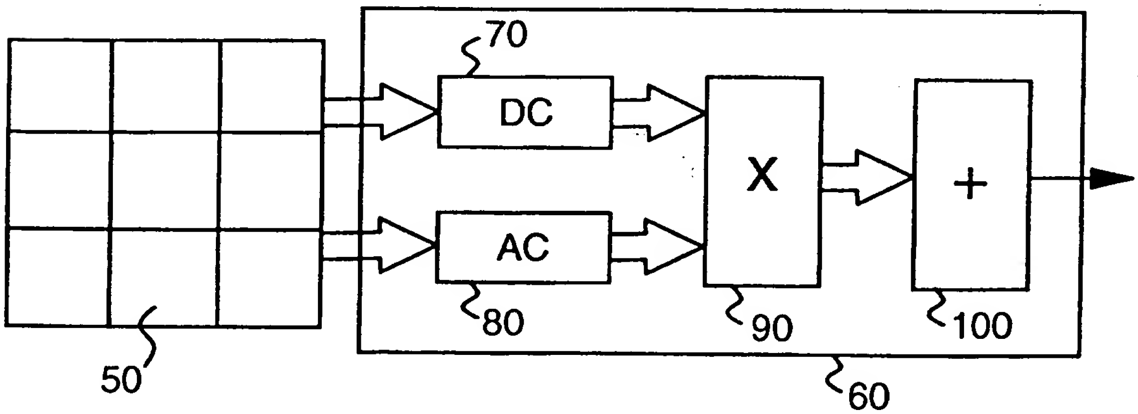

Figure 3

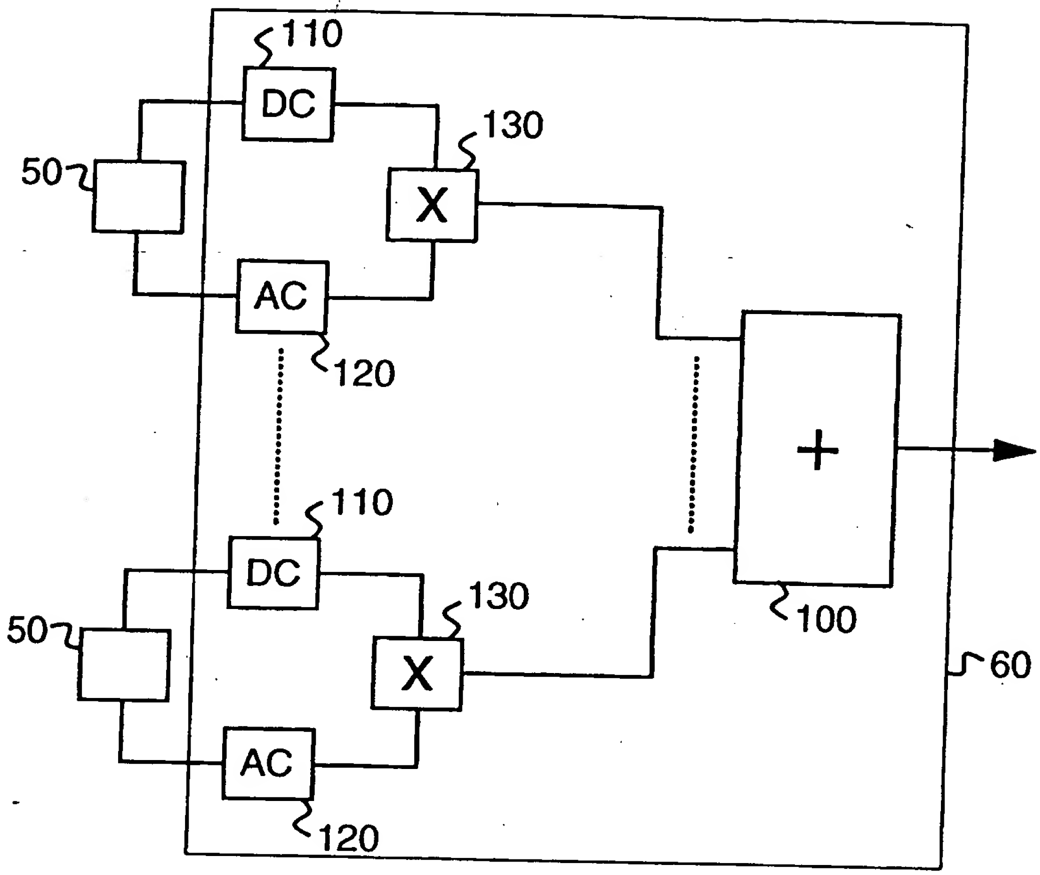

Figure 4

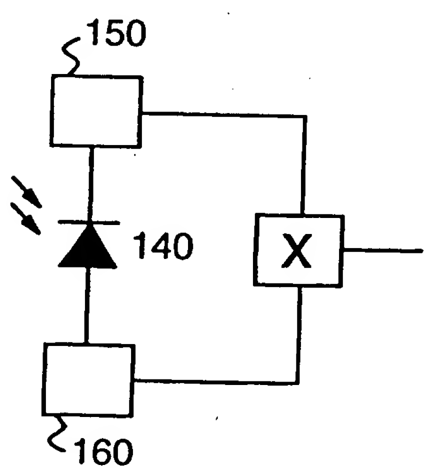

Figure 5

If the end of the fibre 30 spans two or more photo-sensors 50, then each of the corresponding multiplier circuits 130 produces an output when light is carried along the fibre 30. The outputs from the multiplier circuits 130 are combined by the summation circuitry 100 to produce the output signal from the detector 20.

It will be appreciated therefore that the controller 60 effectively selects only the outputs from photo-sensors 50 receiving light from the fibre 30. The output from the detector 20 is then generated by the controller 60 as a function of the selected outputs. The outputs from the photo-sensors 50 outside the image projected onto the array are discounted. Any noise signals produced by the discounted photo-sensors 50 are suppressed by the corresponding multiplier circuits 130. The multiplier circuits 130 thus advantageously improve noise rejection by the detector 20. It should now be recognised that precision mechanical alignment of the fibre 30 relative to the array is avoided. Instead, automatic alignment is effectively provided electronically by the controller 60 detecting actuated photo-sensors 50.

In an embodiment of the present invention herein before described, each photo-sensor 50 in the array was associated with a different DC extraction circuit 110, AC extraction circuit 120, and multiplier circuit 130. However, in other embodiments of the present invention one or more of the inputs and outputs of the DC extraction circuitry 70, AC extraction circuitry 80, and multiplier circuitry 90 may be multiplexed. In alternative embodiments of the present invention, the DC extraction circuitry 70 may be replaced by circuitry for determining AC signal strength. It will be appreciated that the multiplier circuitry 90 may be linear or non-linear in operation. Therefore, in some embodiments of the present invention, the multiplier circuitry 90 may perform a non-linear function instead of a linear function. Such a non-linear function may for example be performed by a switch. It will also be such a non-linear function may include a degree of hysteresis.

The detector 30 may be conveniently embodied in an application specific integrated circuit (ASIC). In the interests of high speed optoelectronic operation, the ASIC embodying the detector 30 is fabricated in Gallium Arsenide. However, in other embodiments of the present invention,

other high speed optoelectronic semiconductor technologies may employed. It will be appreciated that, in some embodiments of the present invention, examples of the detector 20 and the transmitter 10 herein before described may be integrated in a unitary transceiver module for both receiving data from, and transmitting data to a remote network node via the optical fibre 30.